C H A P T E R **16**

CE-100T-8 Ethernet Operation

This chapter covers the operation of the CE-100T-8 (Carrier Ethernet) card supported on the ONS 15310 (15310-CE-100T-8). A CE-100T-8 card is also supported on the ONS 15454 (15454-CE-100T-8). Provisioning is done through Cisco Transport Controller (CTC) or Transaction Language One (TL1). Cisco IOS is not supported on the CE-100T-8 card.

For Ethernet card specifications, refer to the *Cisco ONS 15310-CL Reference Manual*. For step-by-step Ethernet card circuit configuration procedures and hard-reset and soft-reset procedures, refer to the *Cisco ONS 15310-CL Procedure Guide*. Refer to the *Cisco ONS SONET TL1 Command Guide* for TL1 provisioning commands. For specific details on ONS 15310-CL Ethernet card interoperability with other ONS platforms, refer to the "POS on ONS Ethernet Cards" chapter of the *Ethernet Card Software Feature and Configuration Guide for the ONS 15454 SDH, ONS 15454, and ONS 15327*.

Chapter topics include:

CE-100T-8 Overview

The CE-100T-8 is a Layer 1 mapper card with eight 10/100 Ethernet ports. It maps each port to a unique SONET circuit in a point-to-point configuration. Figure 16-1 illustrates a sample CE-100T-8 application. In this example, data traffic from the Fast Ethernet port of a switch travels across the point-to-point circuit to the Fast Ethernet port of another switch.

Figure 16-1   CE-100T-8 Point-to-Point Circuit
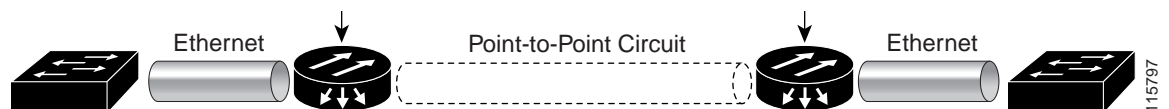
The CE-100T-8 cards allow you to provision and manage an Ethernet private line service like a traditional SONET line. CE-100T-8 card applications include providing Ethernet private line services and high-availability transport.

The CE-100T-8 card supports ITU-T G.707 and Telcordia GR-253 based standards for SONET. It offers a carrier-class level of features and reliability. This includes errorless (0-msec impact on traffic) reprovisioning. When circuit or port provisioning takes place, this operation does not affect the performance of other ports and circuit configurations that are already established on the card.

Software upgrades are errorless. However when the CE-100T-8 firmware is upgraded, the upgrade has an effect on traffic similar to the effect of a hard reset on the CE-100T-8. A software upgrade or a firmware upgrade does not affect the existing provisioning of the ports and circuits on the CE-100T-8 card.

Span upgrades are hitless. Protection and maintenance switches are also hitless.

The CE-100T-8 offers full TL1-based provisioning capability. Refer to the *Cisco ONS SONET TL1 Command Guide* for CE-100T-8 TL1 provisioning commands.

CE-100T-8 Ethernet Features

The CE-100T-8 card has eight front-end Ethernet ports which use standard RJ-45 connectors for 10BASE-T Ethernet/100BASE-TX Ethernet media. Ethernet Ports 1 through 8 each map to a POS port with a corresponding number. The console port on the CE-100T-8 card is not functional.

The CE-100T-8 cards forward valid Ethernet frames unmodified over the SONET network. Information in the headers is not affected by the encapsulation and transport. For example, included IEEE 802.1Q information will travel through the process unaffected.

The ONS 15454 CE-100T-8 and the ONS 15310 CE-100T-8 support maximum Ethernet frame sizes of 1600 bytes including the CRC. The MTU size is not configureable and is set at a 1500 byte maximum (standard Ethernet MTU). Baby giant frames in which the standard Ethernet frame is augmented by 802.1 Q tags or MPLS tags are also supported. Full Jumbo frames (9000 byte maximum) are not supported.

The CE-100T-8 cards discard certain types of erroneous Ethernet frames rather than transport them over SONET. Erroneous Ethernet frames include corrupted frames with cyclic redundancy check (CRC) errors and undersized frames that do not conform to the minimum 64-byte length Ethernet standard.

Note   Many Ethernet attributes are also available through the network element default feature. For more information on NE defaults, refer to the "Network Element Defaults" appendix in the Cisco ONS 15454 Reference Manual.

Autonegotiation, Flow Control, and Frame Buffering

On the CE-100T-8, Ethernet link autonegotiation is on by default. The user can also set the link speed, duplex, and flow control manually under the card-level Provisioning tab of CTC.

The CE-100T-8 supports IEEE 802.3x flow control and frame buffering to reduce data traffic congestion. Flow control is on by default.

To prevent over-subscription, buffer memory is available for each port. When the buffer memory on the Ethernet port nears capacity, the CE-100T-8 uses IEEE 802.3x flow control to transmit a pause frame to the attached Ethernet device. Flow control and autonegotiation frames are local to the Fast Ethernet interfaces and the attached Ethernet devices. These frames do not continue through the POS ports.

The CE-100T-8 card has symmetric flow control and proposes symmetric flow control when autonegotiating flow control with attached Ethernet devices. Symmetric flow control allows the CE-100T-8 cards to respond to pause frames sent from external devices and to send pause frames to external devices.

The pause frame instructs the source to stop sending packets for a specific period of time. The sending station waits the requested amount of time before sending more data. Figure 16-2 illustrates pause frames being sent and received by CE-100T-8 cards and attached switches.

Figure 16-2   Flow Control
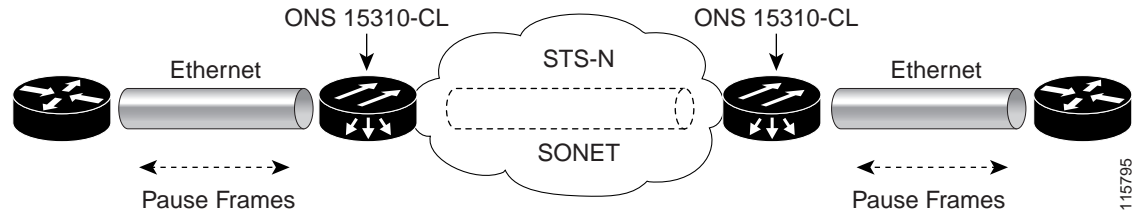
This flow-control mechanism matches the sending and receiving device throughput to that of the bandwidth of the STS circuit. For example, a router might transmit to the Ethernet port on the CE-100T-8 card. This particular data rate might occasionally exceed 51.84 Mbps, but the SONET circuit assigned to the CE-100T-8 port might be only STS-1 (51.84 Mbps). In this example, the CE-100T-8 sends out a pause frame and requests that the router delay its transmission for a certain period of time. With flow control and a substantial per-port buffering capability, a private line service provisioned at less than full line rate capacity (STS-1) is efficient because frame loss can be controlled to a large extent.

Ethernet Link Integrity Support

The CE-100T-8 supports end-to-end Ethernet link integrity (Figure 16-3). This capability is integral to providing an Ethernet private line service and correct operation of Layer 2 and Layer 3 protocols on the attached Ethernet devices.

End-to-end Ethernet link integrity means that if any part of the end-to-end path fails, the entire path fails. It disables the Ethernet port on the CE-100T-8 card if the remote Ethernet port is unable to transmit over the SONET network or if the remote Ethernet port is disabled.

Failure of the entire path is ensured by turning off the transmit pair at each end of the path. The attached Ethernet devices recognize the disabled transmit pair as a loss of carrier and consequently an inactive link or link fail.

Figure 16-3   End-to-End Ethernet Link Integrity Support

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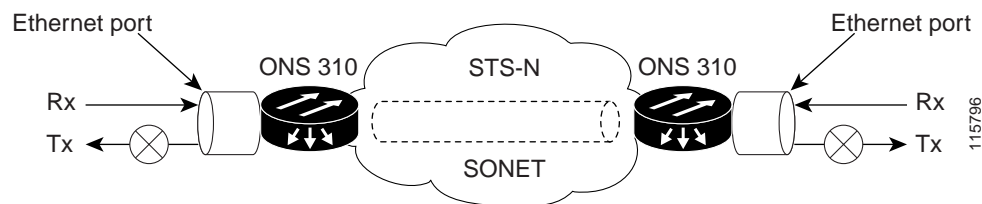
Note   Some network devices can be configured to ignore a loss of carrier condition. If a device configured to ignore a loss of carrier condition attaches to a CE-100T-8 card at one end, alternative techniques (such as use of Layer 2 or Layer 3 keep-alive messages) are required to route traffic around failures. The response time of such alternate techniques is typically much longer than techniques that use link state as indications of an error condition.

IEEE 802.1Q CoS and IP ToS Queuing

The CE-100T-8 references IEEE 802.1Q class of service (CoS) thresholds and IP type of service (ToS) (IP Differentiated Services Code Point [DSCP]) thresholds for priority queueing. CoS and ToS thresholds for the CE-100T-8 are provisioned on a per port level. This allows the user to provide priority treatment based on open standard quality of service (QoS) schemes already existing in the data network attached to the CE-100T-8. The QoS treatment is applied to both Ethernet and POS ports.

Any packet or frame with a priority greater than the set threshold is treated as priority traffic. This priority traffic is sent to the priority queue instead of the normal queue. When buffering occurs, packets on the priority queue preempt packets on the normal queue. This results in lower latency for the priority traffic, which is often latency-sensitive traffic, such as VoIP.

Because these priorities are placed on separate queues, the priority queuing feature should not be used to separate rate-based CIR/EIR marked traffic (sometimes done at a Metro Ethernet service provider edge). This could result in out-of-order packet delivery for packets of the same application, which would cause performance issues with some applications.

For an IP ToS-tagged packet, the CE-100T-8 can map any of the 256 priorities specified in IP ToS to priority or best effort. The user can configure a different ToS on CTC at the card-level view under the Provisioning > Ether Ports tabs. Any ToS class higher than the class specified in CTC is mapped to the priority queue, which is the queue geared towards low latency. By default, the ToS is set to 255, which is the highest ToS value. This results in all traffic being treated with equal priority by default.

Table 16-3 shows which values are mapped to the priority queue for sample IP ToS settings. (ToS settings span the full 0 to 255 range, but only selected settings are shown.)

Table 16-1   IP ToS Priority Queue Mappings

ToS Setting in CTC	ToS Values Sent to Priority Queue
255 (default)	None
250	251–255
150	151–255
100	101–255
50	51–255
0	1–255

For a CoS-tagged frame, the CE-100T-8 can map the eight priorities specified in CoS to priority or best effort. The user can configure a different CoS on CTC at the card-level view under the **Provisioning > Ether Ports** tabs. Any CoS class higher than the class specified in CTC is mapped to the priority queue, which is the queue geared towards low latency. By default, the CoS is set to 7, which is the highest CoS value. This results in all traffic being treated with equal priority by default.

Table 16-3 shows which values are mapped to the priority queue for CoS settings.

Table 16-2   CoS Priority Queue Mappings

CoS Setting in CTC	CoS Values Sent to Priority Queue
7 (default)	none
6	7
5	6, 7
4	5, 6, 7
3	4, 5, 6, 7
2	3, 4, 5, 6, 7
1	2, 3, 4, 5, 6, 7
0	1, 2, 3, 4, 5, 6, 7

Ethernet frames without VLAN tagging use ToS-based priority queueing if both ToS and CoS priority queueing is active on the card. The CE-100T-8 card's ToS setting must be lower than 255 (default) and the CoS setting lower than 7 (default) for CoS and ToS priority queueing to be active. A ToS setting of 255 (default) disables ToS priority queueing, so in this case the CoS setting would be used.

Ethernet frames with VLAN tagging use CoS-based priority queueing if both ToS and CoS are active on the card. The ToS setting is ignored. CoS based priority queueing is disabled if the CoS setting is the 7 (default), so in this case the ToS setting would be used.

If the CE-100T-8 card's ToS setting is 255 (default) and the CoS setting is 7 (default), priority queueing is not active on the card, and data gets sent to the default normal traffic queue. Also if data is not tagged with a ToS value or a CoS value before it enters the CE-100T-8 card, it gets sent to the default normal traffic queue.

Note   Priority queuing has no effect when flow control is enabled (default) on the CE-100T-8. Under flow control a 6 kilobyte single-priority first in first out (FIFO) buffer fills, then a PAUSE frame is sent. This results in the packet ordering priority becoming the responsibility of the external device, which is buffering as a result of receiving the PAUSE flow-control frames.

Note   Priority queuing has no effect when the CE-100T-8 is provisioned with STS-3C circuits. The STS-3c circuit has more data capacity than Fast Ethernet, so CE-100T-8 buffering is not needed. Priority queuing only takes effect when buffering occurs.

RMON and SNMP Support

The CE-100T-8 card features remote monitoring (RMON) that allows network operators to monitor the health of the network with a network management system (NMS). The CE-100T-8 uses the ONG RMON. The ONG RMON contains the statistics, history, alarms, and events MIB groups from the standard RMON MIB, as well as Simple Network Management Protocol (SNMP). A user can access RMON threshold provisioning through TL1 or CTC. For RMON threshold provisioning with CTC, see the *Cisco ONS 15310-CL Procedure Guide* and the *Cisco ONS 15310-CL Troubleshooting Guide*. For TL1 information, see the *Cisco ONS SONET TL1 Command Guide*.

Statistics and Counters

The CE-100T-8 has a full range of Ethernet and POS statistics under **Performance > Ether Ports** or **Performance > POS Ports**. These are detailed in the "Performance Monitoring" chapter of the *Cisco ONS 15310 Reference Manual.*

CE-100T-8 SONET Circuits and Features

The CE-100T-8 has eight POS ports, numbered one through eight, which are exposed to management with CTC or TL1. Each POS port is statically mapped to a matching Ethernet port. By clicking the card-level Provisioning tab > POS Ports tab, the user can configure the Administrative State, Framing Type, and Encapsulation Type. By clicking the card-level Performance tab > POS Ports tab, the user can view the statistics, utilization, and history for the POS ports.

Available Circuit Sizes and Combinations

Each POS port terminates an independent contiguous SONET concatenation (CCAT) or virtual SONET concatenation (VCAT). The SONET circuit is created for these ports through CTC or TL1 in the same manner as a SONET circuit for a non-Ethernet line card. Table 16-3 shows the circuit sizes available for the CE-100T-8 on the ONS 15310-CL.

Table 16-3   CE-100T-8 Supported Circuit Sizes

CCAT High Order	VCAT High Order	VCAT Low Order
STS-1	STS-1-1v	VT1.5-nV *(n= 1 to 64)*
STS-3c	STS-1-2v	
	STS-1-3v	

A single circuit provides a maximum of 100 Mbps of throughput, even when an STS-3c circuit, which has a bandwidth equivalent of 155 Mbps, is provisioned. This is due to the hardware restriction of the Fast Ethernet port. A VCAT circuit is also restricted in this manner. Table 16-3 shows the minimum SONET circuit sizes required for 10 Mbps and 100 Mbps wire speed service.

Table 16-4   SONET Circuit Size Required for Ethernet Wire Speeds

Ethernet Wire Speed	CCAT High Order	VCAT High Order	VCAT Low Order
Line Rate 100BaseT	STS-3c	STS-1-3v, STS-1-2v*	Not applicable
Sub Rate 100BaseT	STS-1	STS-1-1v	VT1.5-xV (x=1-64)
Line Rate 10BaseT	STS-1	Not applicable	VT1.5-7V
Sub Rate 10BaseT	Not applicable	Not applicable	VT1.5-xV (x=1-6)

*STS-1-2v provides a total transport capacity of 98 Mbps.

The number of available circuits and total combined bandwidth for the CE-100T-8 depends on the combination of circuit sizes configured. Table 16-5 shows the circuit size combinations available for CE-100T-8 CCAT high-order circuits on the ONS 15310-CL. Table 16-6 shows the circuit size combinations available for CE-100T-8 VCAT high-order circuits on the ONS 15310-CL.

Table 16-5   CCAT High Order Circuit Size Combinations

Number of STS-3c Circuits	Maximum Number of STS-1 Circuits
None	6
1	3
2	None

Table 16-6   VCAT High Order Circuit Size Combinations

Number of STS-1-3v Circuits	Maximum Number of STS-1-2v Circuits
None	2
1	1
2	None

The CE-100T-8 supports up to eight low order VCAT circuits. The available circuit sizes are VT1.5-nv, where n ranges from 1 to 64. The total number of VT members cannot exceed 168 VT1.5s with each of the two pools on the card supporting 84 VT1.5s. The user can create a maximum of two circuits at the largest low order VCAT circuit size, VT1.5-64v.

A user can combine CCAT high order, VCAT high order, and VCAT low order circuits in any way as long as there is a maximum of eight circuits and the mapper chip bandwidth restrictions are observed. The following table details the maximum density service combinations.

Table 16-7   CE-100T-8 Maximum Service Densities

Service Combination	STS-3c or STS-1-3v	STS-1-2v	STS-1	VT1.5-xV (x=1-7)	Number of Active Service
1	2	0	0	0	2
2	1	1	1	0	3
3	1	0	3	0	4
4	1	0	0	7(x=1-12)*	8*
5	0	2	2	0	4
6	0	1	1	6(x=1-14)	8
7	0	1	0	7(x=1-12)*	8*
8	0	0	6	0	6
9	0	0	3	5(x=1-16)	8
10	0	0	0	8 (x=1-21)	8

* This LO-VCAT Circuit combination is achievable if the first circuit created on the card is an LO VCAT circuit. If the first circuit created on the card is HO-VCAT or CCAT STS circuits, then a maximum of six LO-VCAT circuits can be added on the card.

CE-100T-8 STS/VT Allocation Tab

The CE-100T-8 has two pools, each with a maximum capacity of three STSs. At the CTC card-level view under the Maintenance tab, the STS/VT Allocation tab displays how the provisioned circuits populate the two pools. This information can be useful in freeing up the bandwidth required for provisioning a circuit, if there is not enough existing capacity on any one pool for provisioning the desired circuit. The user can look at the distribution of the existing circuits among the two pools and decide which circuits to delete in order to free up space for the desired circuit.

Figure 16-4   CE-100T-8 STS/VT Allocation Tab

Port 5 belongs to Pool 2

For example if a user needs to provision an STS-3c or STS-1-3v on the CE-100T-8 card shown in Figure 16-4, an STS-3c or STS-1-3v worth of bandwidth is not available from either of the two pools. The user needs to delete circuits from the same pool to free up bandwidth. If the bandwidth is available but scattered among the pools, the circuit cannot be provisioned.

Looking at the POS Port Map table, the user can determine which circuits belong to which pools. The Pool and Port columns in Figure 16-4 show that the circuit on port 5 is drawn from Pool 2, and no other circuits are drawn from Pool 2. Deleting this one circuit will free up an STS-3c or STS-1-3v worth of bandwidth from a single pool.

The POS Port table has a row for each port with three columns (Figure 16-4). They show the port number, the circuit size and type, and the pool it is drawn from. The Pool Utilization table has two columns and shows the pool number, the type of circuits on that pool, how much of the pool's capacity is being used, and whether additional capacity is available.

CE-100T-8 VCAT Characteristics

The ML-100T-8 card and the CE-100T-8 card (both the ONS 15310-CL version and the ONS 15454 SONET/SDH version) have hardware-based support for the ITU-T G.7042 standard link capacity adjustment scheme (LCAS). This allows the user to dynamically resize a high order or low order VCAT circuit through CTC or TL1 without affecting other members of the VCG (errorless). ML-100T-8 LCAS support is high order only and is limited to a two member VCG.

The ONS 15454 SONET/SDH ML-Series card has a software-based LCAS (SW-LCAS) scheme. This scheme is also supported by both the ML-100T-8 card and both versions of the CE-100T-8, but only for circuits terminating on a ONS 15454 SONET/SDH ML-Series card.

The CE-100T-8 card allows independent routing and protection preferences for each member of a VCAT circuit. The user can also control the amount of VCAT circuit capacity that is fully protected, unprotected or if the circuit is on a bidirectional line switched ring (BLSR), uses protection channel access (PCA). Alarms are supported on a per-member as well as per virtual concatenation group (VCG) basis.

Note The maximum tolerable VCAT differential delay for the CE-100T-8 is 48 milliseconds. The VCAT differential delay is the relative arrival time measurement between members of a virtual concatenation group (VCG).

CE-100T-8 POS Encapsulation, Framing, and CRC

The CE-100T-8 uses Cisco EoS LEX (LEX). LEX is the primary encapsulation of ONS Ethernet cards. In this encapsulation the protocol field is set to the values specified in Internet Engineering Task Force (IETF) Request For Comments (RFC) 1841. The user can provision GPF-F framing (default) or high-level data link control (HDLC) framing. With GFP-F framing, the user can also configure a 32-bit CRC (the default) or no CRC (none). When LEX is used over GFP-F it is standard Mapped Ethernet over GFP-F according to ITU-T G.7041. HDLC framing provides a set 32-bit CRC.

Figure 16-5 illustrates CE-100T-8 framing and encapsulation.

Figure 16-5   ONS CE-100T-8 Encapsulation and Framing Options
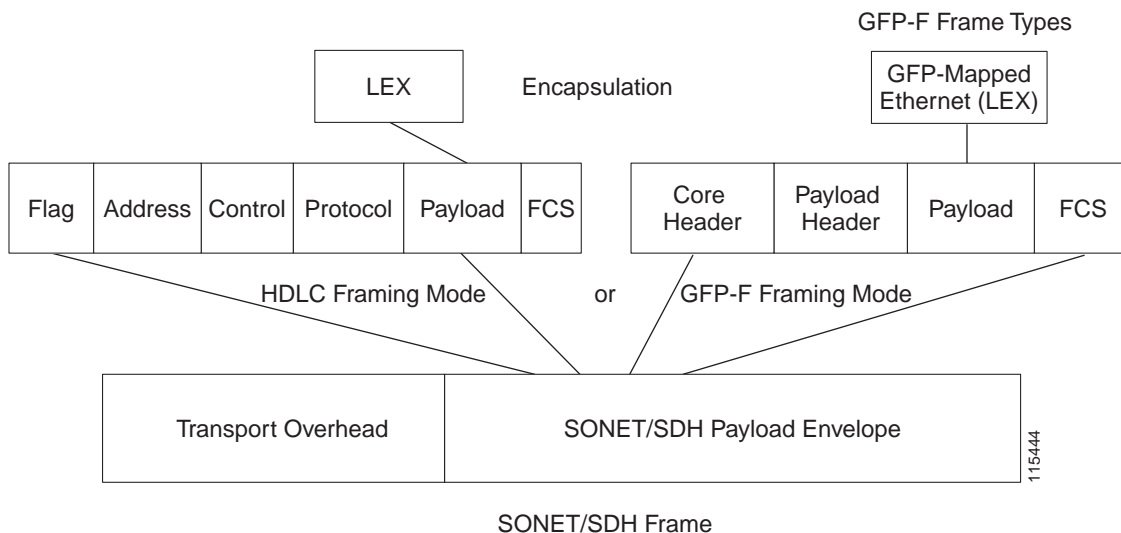
The CE-100T-8 card supports GFP-F null mode. GFP-F CMFs are counted and discarded.

The CE-100T-8 card is interoperable with the ML-100T-8 card and several other ONS Ethernet cards. For specific details on ONS Ethernet card interoperability, refer to the "POS on ONS Ethernet Cards" chapter of the *Ethernet Card Guide Software Feature and Configuration Guide—for the ONS 15454, ONS 15454 SDH and ONS 15327*.

CE-100T-8 Loopback, J1 Path Trace, and SONET Alarms

The CE-100T-8 card supports terminal and facility loopbacks when in the Out of Service, Maintenance state (OOS, MT). It also reports SONET alarms and transmits and monitors the J1 Path Trace byte in the same manner as OC-N cards. Support for path termination functions includes:

- H1 and H2 concatenation indication
- C2 signal label
- Bit interleaved parity 3 (BIP-3) generation
- G1 path status indication
- C2 path signal label read/write
- Path level alarms and conditions, including loss of pointer, unequipped, payload mismatch, alarm indication signal (AIS) detection, and remote defect indication (RDI)
- J1 path trace for high order paths
- J2 path trace for low order paths
- J2 path trace for low order VCAT circuits at the member level
- Extended signal label for the low order paths